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ABSTRACT

The problems of relating research to practice are discussed in the context of what, why, and how. The what of recent research is illustrated by examples which suggest that media-related research is becoming more rigorous, analytical, and theoretical, and thus more reliable and generally applicable. The why is briefly argued with reference to the greater reliability of research-based information over that learned on the job by an individual practitioner. The how is considered by noting the large available reservoir of relevant findings and by describing a way of cognitively relating the practitioner's questions to the researcher's findings through their common interest in relating instructional conditions to instructional effects. A list of references is provided. (Author/RAO)

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RELATING BEHAVIORAL SCIENCE RESEARCH TO PRACTICE: WHAT, WHY, HOW

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Abstract

The troubling problem of relating research to practice is discussed with reference to: what, why, how. The what of recent research is illustrated by examples which suggest media-related research is becoming more rigorous, analytical, and theoretical, and thus more reliable and generally applicable. The why is briefly argued with reference to the greater reliability of research-based information over that learned on the job by an individual practitioner. The how is considered by noting the large available reservoir of relevant findings and by describing a way of cognitively relating the practitioner's questions to the researcher's findings through their common interest in relating instructional conditions to instructional effects.

RELATING BEHAVIORAL SCIENCE RESEARCH TO PRACTICE:

WHAT, WHY, HOW

Nine years ago I reported to this group on some perceptual principles for the design of instructional materials. The occasion was the meeting in Detroit of what was then DAVI. I stressed five principles based on perception research: Perception is very selective, is influenced by a prior set to see some things and not others, and is highly organized. Further, auditory perception is specialized for temporal distinctions and visual for spatial distinctions, and finally, pictures of objects are better remembered than their names. Since then Dr. Levie and I have searched out numerous other principles from behavioral science research: 56 from the perception literature, 41 from the memory literature, 27 from the concept learning literature, and 69 from the attitude change literature. These are now packaged in a book entitled Instructional Message Design (1978). Consequently, one of the things this paper will not include is a reiteration of any of those research-based principles for the design of instructional materials. Instead, I will address the general problem of moving research into practice and do so from three perspectives: the what, the why, and the how.

First, the what. Obviously it is impossible in these few minutes to deal adequately with what behavioral science research is being reported today and what part of that is particularly pertinent to instructional designers, developers, and media users. So, I will briefly describe three trends in media-related research and give a few examples of each. Research today

differs from that of twenty years ago in several important ways: it is more rigorous, more analytical, and more theoretical. Although these characteristics of research may fail to describe the applied research which many professional practitioners identify with, I will argue and give examples to support the opposite view, i.e. that it is the rigorous, analytic and theoretical research that best serves the practitioners needs.

Trend number one, more rigor. The idea of rigor is simply that research is better conceptualized and better controlled, and hence more reliable. This frequently takes the form of replicating prior studies or re-addressing previously studied problems with improved procedures. For example, there was a long-accepted principle that knowledge of correct responses (KCR) would be reinforcing to the learner and hence would be associated with increased learning. This was also a basic ~~tenant~~ tenet of programed instruction (PI), until study after study failed to support it. A study by Anderson, Kulhavy and Andre (1971) took a more rigorous approach. These investigators noted that reinforcement (KCR) was by definition, to follow the correct response and, further that the response was to be made to the criterial cues. Most prior PI studies had not controlled for these factors. Subjects could peak at the correct response before responding and could readily do so without paying much attention to the criterial cues. Consequently, conditions were arranged, by way of computer terminals, such that subjects were required to respond before receiving KCR and were variously encouraged to give careful attention to criterial cues. The results, for once, showed a significant difference in recall favoring the KCR condition over the no KCR. This seemed to resolve the issue, but Anderson and Kulhavy went further, they replicated the study but included both Peak and

No-peak conditions in a controlled comparison. The "Peak" group made higher within-program scores, but the No-Peak group made significantly superior recall scores after the program. Increased research rigor, thus, produced more reliable findings which are of direct relevance to practitioners.

In another series of studies, Levin and his associates had been studying the effects of two treatments on children's learning of prose stories. Repeatedly, the prose-plus-related-pictures condition was superior to the prose alone, the stories being read aloud in both cases. For investigators interested in picture effects, these results were quite positive, but rigor required that they consider plausible alternative interpretations of these data. One alternative was that the pictures contributed nothing uniquely attributable to their being pictures, for they might be serving only as a repetition of the story, which repetition could as well have been provided verbally. A follow-up study (Levin, 1976) included a verbal repetition condition in which each sentence was repeated aloud either by the narrator or by the learner. Results showed that verbal repetition increased learning over no-repetition, but the single verbal plus pictures was still significantly superior to all other conditions.

A more general sign of greater rigor in our field is the marked reduction in the number of gross media comparisons, for such studies are generally both conceptually weak and procedurally very difficult to control.

Trend number two, more <u>analytical</u>. The most apparent indication of increasingly analytical research is the greater numbers of independent variables examined in a study, i.e. not just media variables but also learner variables and subject matter or task variables. There is also an increase in the diversity of dependent variables, i.e., not just recall,

but also recognition, concept learning, problem solving, attitude change, and physiological changes. Regarding learner variables, for example, a greater diversity of attributes are being examined, e.g., sex, cognitive style, development level. Results include much evidence that females are generally more skilled in verbal tasks than males, while there is some evidence that males are generally more skilled in some spatial tasks than females.

People also differ in important ways called cognitive style. For example, some are more skilled than others at distinguishing a simple visual figure from a complex background. A surprisingly large amount of research has been done with this basic visual perception skill, some of it demonstrating a relationship to other cognitive skills and even to social skills. This so-called cognitive style is not related to general intelligence but does seem related to the type of school subject and type of instruction method that learners can most readily cope with. Subjects who are most skilled at separating figures from complex grounds (called field-independents) tend to be more analytical, prefer science courses and and working alone, and are better able to organize information themselves. Subjects least skilled at figure-ground separation (called field-dependents) tend to be cognitively more global, prefer social studies courses and working with people, and learn best from well organized learning materials (Witkin, et al., 1979). These more analytical findings all have interesting implications for instructional developers.

Pictures are also being studied more analytically. For example, Margaret Hagen (1974) has been studying how we perceive pictures and to what extent and in what ways we must learn to perceive them. The literature is

contradictory, but it does appear that infants can recognize without training a picture of a familiar object. However, skill in perceiving certain aspects of complex pictures must apparently be learned. For example, we must learn to adjust to impoverished information e.g. lack of certain depth cues in flat pictures, and lack of motion cues in still pictures, and must learn to interrelate various shades, textures, and forms so as to reduce their ambiguity. Jean Mandler (1976) has studied the kinds of information which people selectively remember in pictures. Evidence to date suggests that the identity of objects in a picture is remembered best, the spatial location of those objects somewhat less well, and the interior details of the objects least well. Needless to say, these analytical studies are highly relevant to professional practice in our field.

Analytical studies produce quantities of findings which are complexly related to numerous variables. The effect is to greatly complicate the task of interrelating such studies so as to summarize, generalize and form some useful conclusions. It is here that overriding conceptualizations, models, and theories are indispensable.

Trend number three, more theory. Theories are not only more general than individual findings, they also explain why, and thus are of great potential utility.

Although numerous theories have been generated, it is still not clear why pictures are more memorable than words, but the effort to explain this general finding has produced much important research. For example, several conditions have been identified in which pictures are not superior, e.g., where the pictures are presented at a rapid rate and also where they are quite similar to each other.

One of the best supported theories is dual-coding, i.e., that pictures are more memorable because they are more likely to be coded twice, both imaginally and verbally, and dually stored. Words are less memorable because they are less likely to be dually coded and stored. However, it is clear that both are readily recoded, i.e., we see a picture of a friend and think of his name or we hear or read his name and think of a mental picture of his face. The consequences of this for media professionals are potentially shattering, for the cognitive effects of our stimuli are not given by their objective form--the effect of a concrete picture may be an abstract verbal concept. Like it or not, these and other theoretical insights will change our professional practice.

Dual-coding theory is similar to others in which explanations are sought at the processing level through such questions as: How are external stimuli represented internally, how are they changed/translated/elaborated during such processing, how are they stored in memory, and how are they ~~retreived~~ retrieved and re-presented to awareness?

A contemporary theoretical account is called depth-of-processing, i.e., the greater the depth (or breadth) of processing of a picture or word the greater the recall. For example, Bower and Karlin (1974) found significant differences in recognition memory for pictures of people depending on the depth of processing presumably induced. Subjects instructed only to judge the sex of the pictured people remembered the pictures less well than those instructed to judge the honesty or the likeableness of the people. One of the implications for message designers is that the mere presentation of pictures is not enough. The learner must be further involved in studying them (by way of introduction or task), in attending to the most critical

aspects (by way of pointers, captions), in thinking about them (by way of answering questions, solving problems). This theoretical research thus yields another practical insight: the learner must process information in more than superficial ways, and can be influenced to do so by appropriate instructional design.

Theoretically oriented research on visual processing has produced many very interesting and relevant insights for our field. The mental representation of a picture, object or event, i.e. a picture in the mind, has been shown to participate in numerous cognitive processes. A mental image can markedly facilitate memory for both words and pictures (Paivio, 1971); it appears to contribute to concept formation by representing the most common or prototypic examples of the concept (Rosch, 1978); it appears to function importantly in the solving of spatial problems and of spatial games like chess (Chase and Simon, 1973); it is widely reported to have been the medium of creative and inventive thought used by both artists and scientists, including Einstein, (Shepard, 1978). There is also evidence that thinking visually is a cognitive skill that can be developed through repeated experience with visual media such as film (Salomon, 1978). The implications of such theoretical work on mental imagery are mind boggling, especially for visual media researchers and practitioners.

In sum, I have endeavored to indicate that media-related research has become increasingly rigorous, analytical, and theoretical, and that the effect for professional practitioners has been both an increased reliability and a broader generality of conclusions. So much for the <u>what</u> of relating research to practice.

The why of relating research to practice may need no discussion for this group, it being understood that a profession is characterized by the reliability of its knowledge and the relevance of that knowledge to its practice. If our research does not inform our practice there is little justification for our profession to engage in it. However, one can ask, "Why bother relating research to practice where a seasoned professional will have discovered many of the answers simply by facing a variety of problems, trying a variety of solutions, and observing the results?" One argument for research even under these circumstances is that the practitioner primarily learns from his own individual experience while the researcher generally builds upon the accumulated knowledge of numerous other investigators. Further, researchers generally are more precise in setting up the "test" situation and in analyzing and evaluating the results; and they more regularly go public with their results so that others can criticize them and develop other studies to repeat or contradict the findings. For these several reasons research tends to produce more systematic and reliable information than practice, at least in those domains of human experience that are amenable to research methodology. But in addition to reliability, research must also pass the test of relevance before it can be successfully related to practice. It is here that my third topic, the how of it, comes in. How can research be made relevant to practice?

My answer assumes that the research in question has been or will be well done, i.e. meets the criteria previously described: rigorous, analytical, and theoretical. My answer also assumes that the research is potentially useful to media practitioners, and that includes a surprisingly large proportion of the very extensive body of research on

instruction, learning, and communication. Often a practitioner making a film on earth science for eighth graders, for example, feels that the only relevant research is that on films for eighth grade science. Actually many areas of research may be pertinent: how eighth graders learn in general, the effect of their stage of cognitive development, and their interests; the characteristics of science as a form of knowledge, the differences between learning facts, concepts, and skills; the potential strengths and weaknesses of film in instruction, the fixed pace, the lack of learner control. Also pertinent is the research on the many stimulus elements available in film such as motion, color, pictures vs. words, pictures interacting with words, the sequence or order of pictures and of words, the characteristics of visual perceptual channel vs. auditory channel, etc., etc. The extensive research on all these factors assures that there is no dearth of potentially relevant research findings for the earth science film maker or most any other instructional developer.

Professional practice in our field is frequently represented by a model which depicts a series of steps or operations which the practitioner must perform or supervise. Research is seldom depicted in these procedural models, though it has sometimes been suggested as somehow underlying the procedures or surrounding them, the idea being that practice somehow takes place in a nutrient medium of research. But the general absence of reference to research in development models must be explained in some way, e.g., research is considered irrelevant or only remotely related, or research is assumed throughout and hence not depicted, or knowledge of research (as with other forms of knowledge) doesn't belong in an intrinsically procedural model. I prefer the latter interpretation, that research represents an essential but non-procedural aspect of the process.

While there is important research on development procedures themselves, it is my view that most current research pertinent to design and development impinges on the way in which professionals conceptualize or think about the process. What kinds of thought processes are most productive of viable solutions to design and development decisions? Davies (1971) and others have written about the process of decision making. My concern is with the substance, the content, of the decision-makers thought processes, for it is here that research converges on practice.

Probably the question most central to the developer's thoughts is: What instructional conditions will most effectively and efficiently guide the learner to the competence desired? This reduces to the basic relation between instructional conditions and learning effects, or more fundamentally to the relation between conditions and effects. Both research and practice can identify with this relationship. The researcher's interest is in studying the relation between conditions (the independent variables) and effects (the dependent variables), while the practitioner's interest is in deciding which condition will most likely produce the effect he desires. It is at this commonly held basic conceptual level, relating conditions to effects, that I believe the rapprochement between research and practice can most appropriately be made. The commonality that makes rapprochement possible can be represented by the parallel forms of two statements: one the researcher's conclusions and the other the developer's questions. Researchers conclude:

Certain conditions have lead to certain effects.

Developers ask:

What conditions will lead to the desired effects?

Clearly the juxtaposition of the developer's questions with the appropriate researcher's conclusions has the effect of relating research to practice in a direct way. A designer/developer who conceptualizes, thinks about, and discusses decisions in this way is more likely to make reliable decisions, particularly if he has in mind an adequate supply of reliable statements linking conditions to effects. These linking statements I call instructional design/development principles. Examples are the perception principles cited at this convention almost ten years ago and the numerous others cited since.

Lest anyone think this cognitive matching of research findings and practitioner questions is so pat a process as to automatically produce a correct solution must realize that the principles do not apply to all design/development problems and even where applicable serve only as fairly reliable guides. They must always be tested in each design/development application, i.e., prototypic messages must be given careful formative evaluation.

In sum I have endeavored to report a few examples of recent research in our field that are increasingly rigorous, analytical, and theoretical, and thereby are more reliable and generally useful for professional instructional designers and developers. Further I have provided arguments why much research in instruction, learning, and communication is relevant to our professional practice and have described a cognitive process model for relating research findings to designer/developers questions.

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